of other mixtures of gases than air and this is very easily accomplished by simply connecting the receiving end of the apparatus in the beginning, not at once with the mercury reservoir, but with a gas tank or generator of the gas desired. After a current has been run through the apparatus long enough to ensure the complete replacement of air, the apparatus may then be connected with the mercury supply as before.

There are many operations to which this apparatus is applicable.

Barnard College, Columbia University.

HEXALECTRIS APHYLLUS, A TRUE SAPROPHYTE

By Winifred J. Robinson

The New York Botanical Garden recently received from Mr. R. M. Harper, living specimens of *Hexalectris aphyllus*, collected at Cuthbert, Ga., July 17, 1903, which have unusual interest, from their unique saprophytic character.

The term saprophyte has been applied to plants in all stages of dependence upon organic substances for food, since the time when Aristotle formulated his comprehensive class of humus plants. Pfeffer * says: "Plants which are unable to assimilate carbon dioxide must obtain all their organic food materials from without (heterotrophic or allotrophic nutrition); by others a portion only of their organic food is obtained from the external world, the rest being supplied by the imperfectly developed chlorophyl apparatus (mixotrophic plants)." Green (Intr. to Veg. Phys., 198) states that "the characteristic feature of saprophytes is that they derive at least a part of their food from decaying animal or vegetable matter, absorbing it in some cases as actual food-stuffs, and in others as organic compounds which require relatively little expenditure of energy to build them up into proteids or carbohydrates." MacDougal † takes into account the nutritive unions formed with mycorhizas and bacterial

* Phys. of Plants, translated by Ewart, 1: 363. 1899.

† Symbiosis and Saprophytism. Bull. Torrey Club, 26: 511. 1899.

organisms and restricts the meaning of saprophyte to "those species which derive their supply of food from organic products directly, without the intervention of the activity of chlorophyl and unaided by other organisms." In the last conception of the term, *Wullschlaegelia aphylla*, a near relative of *Neottia*, the so-called bird's-nest orchid, described by Johow, * is the only seed-plant known to be a true saprophyte, with the exception of *Hexalectris aphyllus*.

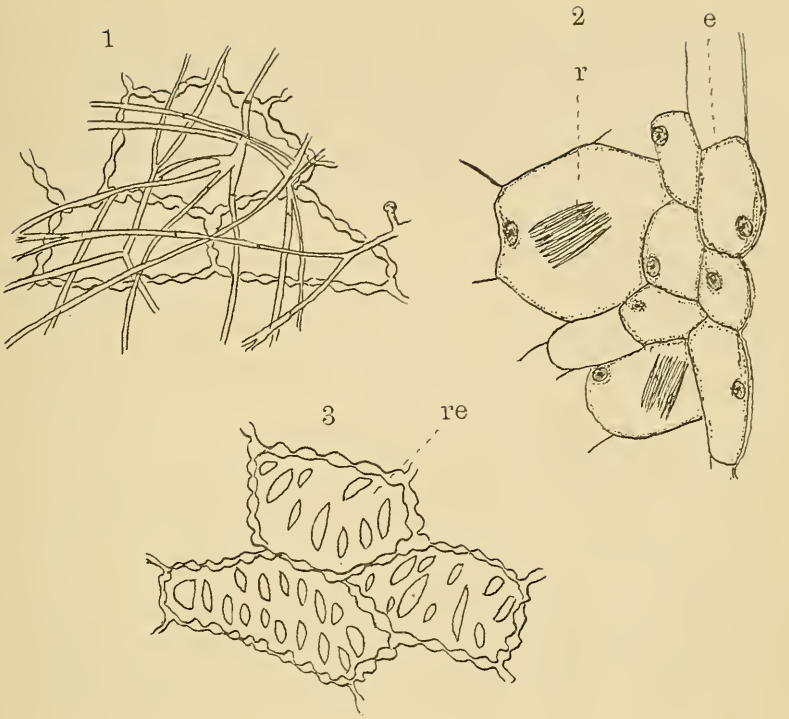
Hexalectris aphyllus is a monotypic orchid of the southern United States and Mexico, where it grows in relatively dry, sandy soil, mixed with humus. It usually occurs singly, and though the rhizomes are perennial, the appearance of the blossom one season by no means assures its being found in the same locality the following year. The plant consists of a fleshy, succulent, scaly rhizome (Figs. 4 and 5) from 7 cm. to 15 cm. long and from 5 mm. to 15 mm. in diameter, which sends out branches from its ring-like nodes and terminates in a scape from 20 cm. to 40 cm. in height. The scape bears purplish scales, the lower truncate and sheathing, the upper acuminate, and terminates in a raceme of from eight to twelve brownish-purple flowers. The rhizome has no roots, though it is wrongly figured in Britton and Brown's "Illustrated Flora" (Fig. 1146) as possessing coralloid roots. It has no trichomes, and no stomata could be found in the epidermis of the rhizome though they are present in small number in the epidermis of the scape and its scale leaves. The epidermis of the rhizome consists of prism-shaped cells flattened radially, their long axes extending in a direction at right angles to that of the axis of the stem. The outer walls have reticulate thickenings (Fig. 3), which correspond in appearance to the epidermal cells of the roots of some epiphytic orchids. They contain protoplasm and have large nuclei (Fig. 2, *e*). Within the epidermis are one or two rows of short columnar cells and within these the large thin-walled turgid cells which form the bulk of the rhizome. The large nucleus in each cell lies in the protoplasm near the wall and the remaining cell contents are fluid with the exception of small bluish granules, probably proteid, in

* Jahrb. wiss. Bot. 16 : 445. 1885.

some cells and the large clusters of needle-like raphides in others which are scattered through the parenchyma, being more numerous near the epidermis than elsewhere (Fig. 2, *r*). No trace of starch could be found. The fibro-vascular bundles consist of a few spirally thickened tracheids and some small proteid-carrying elements.

The epidermal cells of *Hexalectris* are evidently accommodated directly to the absorption of water and food-stuffs, for as Green suggests as to the hairless roots of *Neottia*, "lying in a bed of humus, they do not need such close contact with continually fresh particles of soil as do the roots of the ordinary phanerogam, hence short-lived hairs are unnecessary." * The epidermal cells with their reticulate thickenings may serve, like the velamen cells of the roots of epiphytic orchids, both as a sponge to absorb moisture and also as a protective organ to prevent its escape. The presence of raphides, which are insoluble in water, so near the epidermis may have something to do with the breaking down of the humus compounds which are very slightly soluble in water. The addition of a small quantity of acid causes the raphides to dissolve and thus an acid may make them available to attack the humus. Such crystals are mentioned in the stems or roots of other plants which absorb organic matter, as in *Phoradendron villosum* by Cannon,† in *Grammatophyllum speciosum* by Groom,‡ and in *Cephalanthera Oregana*, by MacDougal.§ Pfeffer || has shown by experiment that some especial apparatus is necessary for making humus available to seed-plants. A few septate filaments of a fungus are found upon the rhizome, scape and seed-capsule of *Hexalectris*, but it cannot be seen to enter the cells at any point nor to come into close contact with them, besides it is not sufficient in quantity to perform the practical work of a symbiont, though its presence may serve to retain moisture near to the epidermal cells. Its presence on the seed-capsule suggests a possible example of Bernard's theory that a

* Intr. to Veg. Phys. 199. 1899.
† Bull. Torrey Club, 28 : 377. 1901.
‡ Ann. Bot. 7 : 146. 1893.
§ Bull. Torrey Club, 26 : 514. 1899.
|| Pfeffer, Phys. of Plants, trans. by Ewart, 1 : 367. 1899.



HEXALECTRIS APHYLLUS.

fungus mycelium is necessary to tuber-formation in orchids, though he states that infection occurs first in the root of the orchid. * In view of the above facts, *Hexalectris aphyllus* may be regarded as a true saprophyte, deriving its nourishment from the disintegrating organic matter of the soil, by the direct absorption of its epidermal cells, with no roots, hairs, or other organs differentiated for absorption.

The herbarium of the New York Botanical Garden contains specimens of *Hexalectris aphyllus* collected as follows: Alabama, Auburn, Lee Co., *L. M. Underwood*, 1896; *S. M. Tracy*, 1897. Arkansas, Little Rock, *Dr. H. E. Hasse*, 1885. Florida, Jacksonville, *H. D. Keeler*, 1870–76; Lake Co., *Geo. V. Nash*, 1895. Georgia, Alcovy Mt., Oconee Co., *J. K. Small*, 1893; Kenesaw Mt., *R. M. Harper*, 1900; Mt. Rachel, Dalton, *Percy Wilson*, 1900. Kentucky, Lexington, *Dr. C. W. Short*, 1835. Missouri, Kennett, *B. F. Bush*, 1895; St. Louis, *H. Eggert*, 1891. North Carolina, Swain Co., *H. C. Beardslee & C. A. Kofoid*, 1891. South Carolina, Paris Mt., *J. K. Small*, 1896. Tennessee, Nashville, *Dr. A. Gattinger*, 1898; Wolf Creek Station, *Thos. H. Kearney*, 1897. Mexico, San Luis Potosi, *Dr. J. G. Schaffner*, 1879.

Explanation of Figures

Hexalectris aphyllus. 1, cells from epidermis with overlying fungus hyphae; 2, epidermal cells (*e*) and raphide-containing cells (*r*); 3, cells from epidermis showing reticulations (*re*); 4, rhizome; 5, rhizome with branches and scape (*s*).

Laboratory of the New York Botanical Garden.

SOME PLANTS OF SOUTHEASTERN VIRGINIA AND CENTRAL NORTH CAROLINA

By Roland M. Harper

On my way to Georgia in June of this year I made in passing through Virginia and North Carolina the following observations, which will add something to our knowledge of the distribution of several interesting plants.

* Bernard, Rév. Gen. Bot. 14: 17. 1902.